OVERVIEW OF THE PHYSIOGRAPHY AND VEGETATION OF VIRGINIA

Stretching over 750 km (450 mi) east to west from the Atlantic Ocean to the Appalachian mountains, the Commonwealth of Virginia spans five of the more than 20 major physiographic provinces found in North America (Fenneman 1938), making it one of the most diverse landscapes – both topographically and floristically – in the East. Because of its location between the glaciated, mountainous regions of the north and the coastal lowlands of the south, Virginia is also uniquely positioned to capture species at or near the southern limit of their range, as well as southern species reaching the northern limits of their distributions, adding to the biotic richness of the state. This combination of landscape diversity and biotic richness leads to the wealth of ecological communities found throughout the state – from the maritime forests of the coastal barrier islands to the spruce forests and shale barrens of the mountains.

To better understand the distribution of ecological communities across Virginia, it may be helpful to briefly examine the characteristics of the state's major topographic regions. This is by no means intended to be a comprehensive overview, but a "broad-brush" look to assist in understanding major vegetation patterns. For more comprehensive treatments of Virginia geology, physiography, and climate readers are referred to Woodward and Hoffman (1991) and the Geology of Virginia website at the College of William and Mary (http://www.wm.edu/CAS/GEOLOGY/virginia/index.html).

General Setting

Virginia covers 109,624 sq km (42,326 sq mi), including 2,590 sq km (1,000 sq mi) of inland water and 4,475 sq km (1,728 sq mi) of coastal waters over which the state has jurisdiction. Roughly triangular in shape, it extends 755 km (469 mi) east to west and 323 km (201 mi) north to south at its widest points. Maximum elevation is reached on the adjacent southern Blue Ridge peaks of Mount Rogers (1,746 m / 5,729 ft) and Whitetop (1,682 m / 5,520 ft) , while its minimum relief is found on the Eastern Shore and Embayed Region of southeastern Virginia (0 m/ft or sea level). Virginia is bounded on the east by the Atlantic Ocean, on the north and east by Maryland and the District of Columbia, on the west by West Virginia and Kentucky, and on the south by Tennessee and North Carolina.

The physiographic provinces that intersect Virginia are generally defined by their relative elevation, relief, geologic structure, and lithology (Fig. 1). Beginning at sea level at the eastern edge of the state, the surface of Virginia rises gradually in elevation and increases in irregularity, until it reaches maximum elevation and ruggedness in the western part of the state. The major physiographic divisions of this surface, from east to west, are the Coastal Plain, the Piedmont Plateau, the Blue Ridge, the Ridge and Valley, and the Appalachian Plateaus. Each province, in turn, is divisible into subregions using geologic and topographic features, climate, biota, or some combination of these factors. Geologists, physiographers, and biogeographers often differ slightly in their delineations of subregions. We will attempt to explain the subregional divisions (indicated in bold italics) that are most commonly employed.

Differences in climate, soils, and overall habitat conditions in each province greatly influence the distribution of individual plant species and the assemblages of plants that represent natural communities. Although there are many species that have wide distributions in the state, differences in the overall vegetation of the Coastal Plain, Piedmont, and Appalachian provinces are pronounced and apparent. To a great extent, these variations reflect the influences of two larger biogeographic floras: that of the northern North America and Appalachian region, and that of the southeastern Atlantic and Gulf slopes and coastal plains. Plants and vegetation characteristic of each biogeographic region are well represented in Virginia, which is situated at latitudes where these great floras intermingle. The patterns of distribution, however, are not simplistic. Gradations in species distributions and larger-scale vegetation patterns are evident on both a north-south axis related primarily to regional climate and the past history of climatic change and plant migrations, and on an east-west axis related primarily to topography and local climatic factors.

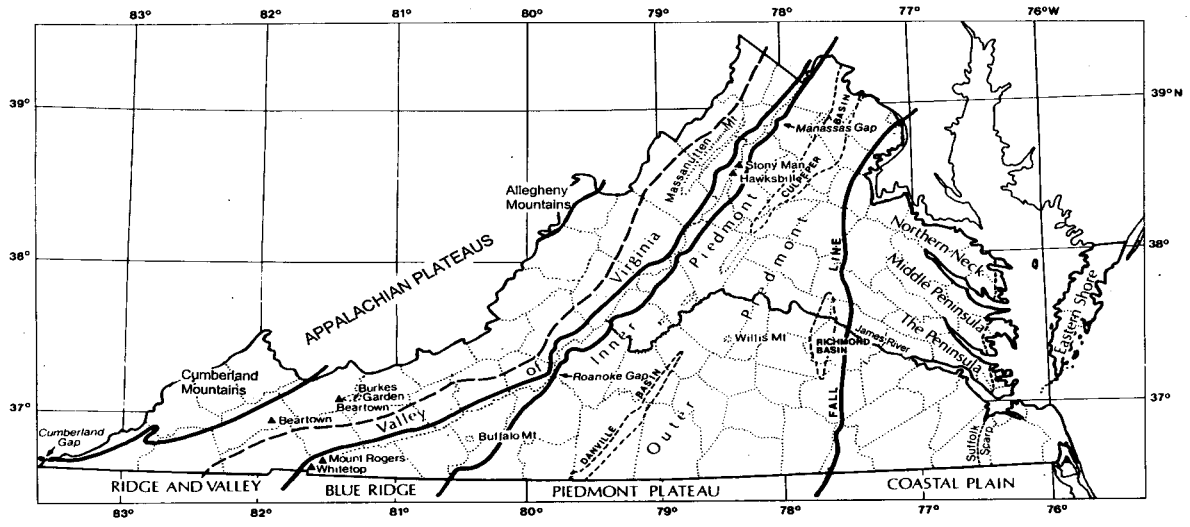


Figure 1. The physiographic provinces and subregions of Virginia. Modified from Woodward and Hoffman (1991), with copyright permission.

The present-day climate of Virginia is generally classified as humid subtropical (Woodward and Hoffman 1991) but within-state variation of temperatures, precipitation, and length of growing season is dramatic. Much of the temperature gradient is related to elevation and distance from the coast, with oceanic influences greatly moderating the climate of near-coastal areas. The relatively warm climate of eastern and southeastern Virginia is closely correlated with a concentration of southern plant species, some of which reach their northern range limits in the state. A regionally cooler climate and pronounced microclimatic variation is present in the Appalachian provinces, where local relief is greatest. Sub-boreal or boreal microclimates prevail at many sites > 1,200 m (4,000 ft) elevation, providing suitable habitat for a large number of plants whose ranges are centered to the north of Virginia.

It is important to note that the contemporary vegetation of Virginia is not static and has developed only recently on the geological time scale. Eighteen thousand years ago, at the peak of the last continental glaciation, the climate in much of Virginia was boreal due to the southward extension of the Laurentide Ice Sheet to northern Pennsylvania. A boreal forest dominated by spruce, along with alpine tundra on the higher Appalachians, covered much of the state, slowly giving way to a mixed conifer–northern hardwoods vegetation over the next several millennia as the ice retreated northward (Delcourt and Delcourt 1993). Only about 9,000 to 10,000 years ago did the boreal-northern forests begin to collapse and shift toward the oak and chestnut dominance that has characterized much of the Holocene (Delcourt and Delcourt 1993, Craig 1969). Ongoing global climate change and the contemporary loss of barriers to the worldwide migration of plants and other organisms will do doubt continue to generate shifts in vegetation distribution and composition across the Commonwealth.

The Coastal Plain

The Atlantic Coastal Plain stretches from Cape Cod south to Florida, extending east from the Fall Line to the North American Continental Shelf, 80 to 120 km (50 to 75 mi) offshore. The Fall Line is a zone of geologic transition that marks the boundary between the older, resistant, metamorphic rocks of the Piedmont and younger, softer, mostly unconsolidated sediments of the Coastal Plain. In Virginia, this boundary roughly corresponds to the route of Interstate 95 between Washington D.C. and Emporia. Virginia's Coastal Plain is a low-relief, terraced landscape that slopes gently toward the Atlantic Ocean

from its highest elevations at the Fall line (~ 75 m / 250 ft). Geologically speaking, this province is a young landscape sculpted during the last few million years by the repeated rising and falling of sea level during several cycles of Pleistocene glaciation. The Coastal Plain is underlain by a wedge of sediments that that increases in thickness from the Fall Line to the continental shelf. Soils tend to be sandy, although deposits of terrace gravels, marine clays, and fossiliferous shells are common locally.

Large marsh complexes are characteristic features of the outer Coastal Plain landscape. North Landing River watershed, City of Virginia Beach. Photo: Curtis Hutto.

The Virginia Coastal Plain is often divided into eastern (outer) and western (inner) sections based on topographic features. The ***outer Coastal Plain*** is an undulating to nearly flat landscape marked by several ancient marine terraces bounded by scarps that mark former Pleistocene shorelines. South of the James River, the outer Coastal Plain lies within the Mid-Atlantic ***Embayed Region***, a region of sounds, embayments, and flatwoods stretching from Back Bay, Virginia to the Neuse River in North Carolina. In Virginia, the Embayed Region includes the Great Dismal Swamp and the North Landing and Northwest Rivers, northern extensions of Currituck Sound. A line through the towns of Suffolk, north to Gloucester and Westmoreland on the Potomac, roughly marks the boundary between the inner and outer coastal plain. East of this line, the outer Coastal Plain does not exceed 180 m (60 ft) elevation and includes the Embayed Region, the western shore of the Chesapeake Bay, and the ***Eastern Shore***, representing the southern end of the Delmarva Peninsula. Lying on the eastern edge of the Eastern shore, and continuing south of the Chesapeake Bay, is a chain of large bay and marsh complexes and barrier islands with both active and stabilized dunes. These islands are dynamic landscapes that are constantly buffeted by powerful wind and waves, eroding on the ocean side and accreting on the sound side.

The ***inner Coastal Plain*** is a broad upland, gently dissected by streams, and locally quite rugged where short, high gradient streams have incised steep ravine systems. Four large tidal rivers – the Potomac, Rappahannock, York, and James – drain the northern part of the inner Coastal Plain, flowing southeastward into the Chesapeake Bay and dissecting the area into three prominent peninsulas. The Northern Neck is the peninsula between the Potomac and Rappahannock Rivers, while the Middle Peninsula lies between the Rappahannock and York Rivers. The area between the York and James Rivers is simply referred to as The Peninsula.

The upland forests that originally covered much of the Virginia Coastal Plain have been extensively cleared or altered, so that it is now difficult to determine which species and natural communities were prevalent. Much of the contemporary forest consists of successional or silvicultural stands of loblolly pine (*Pinus taeda*), and secondary pine-hardwood forests that have developed after repeated cutting or agricultural abandonment. The most mature remnant stands on mesic uplands are characterized by associations of American beech (*Fagus grandifolia*), several oaks (*Quercus* spp.), and American holly (*Ilex opaca* var. *opaca*). Patches of drier oak-dominated forest and steep bluffs with dense forests of chestnut oak (*Quercus montana, = Q. prinus*), beech, and mountain-laurel (*Kalmia latifolia*) are fairly common in the dissected inner Coastal Plain, especially north of the James River. South of the James

River, fire-maintained forests and woodlands dominated by longleaf pine (*Pinus palustris*) may have been prevalent prior to European settlement (Frost 1995), but little trace of these now remains.

Terrestrial communities restricted to special inner Coastal Plain habitats include a few remnant longleaf pine and turkey oak (*Quercus laevis*) woodlands associated with deep sand deposits along the Nottoway and Blackwater Rivers in southeastern Virginia. Rare vegetation types have also developed on ravine slopes and estuarine-fronting bluffs that have down-cut into Tertiary shell deposits or limesands. Soils of the latter habitats have extraordinarily high levels of calcium and support a number of inland, calciphilic species that are disjunct from the mountains.

Swamp forests dominated by water tupelo (*Nyssa aquatica*) and other trees tolerant of prolonged flooding are common throughout the Coastal Plain. Chickahominy River, New Kent County. Photo (c) Irvine Wilson.

Wetlands of the Coastal Plain are extensive and have fared somewhat better than the province's upland forests, supporting a great variety of natural communities. The diversity of wetlands in this region spans a range of freshwater to saline, lunar-tidal estuaries; tidal and palustrine swamps; non-riverine, groundwater-saturated flats; seasonally flooded ponds and depressions; seepage slope wetlands; and various tidal and non-tidal aquatic habitats. Extensive saturated peatlands of the Embayed Region support fire-suppressed, but still locally extensive stands of Atlantic white-cedar (*Chamaecyparis thyoides*) and pocosin vegetation dominated by pond pine (*Pinus serotina*) and evergreen shrubs.

The maritime zone of the outer Coastal Plain is vegetated with a unique suite of pine and pine-hardwood forests, dune woodlands and scrub, and dune grasslands well adapted to deep, very dry sands; periodic salt spray; and oceanic storm impacts. Maritime-zone wetlands include some of the state's rarest natural communities, including sea-level fens, interdune ponds, and maritime swamp forests.

In addition to the distinctions between the inner and outer subregions of the Coastal Plain, phytogeographers (*e.g.*, Braun 1950) also tend to recognize "northern" and "southern" divisions of this province, with the James River serving as a rough boundary. South of the James, a number of southern species and vegetation types reach or approach their northern range limits. Ecological community groups wholly or largely restricted to the ***southern Coastal Plain*** are Longleaf Pine / Scrub Oak Sandhills, Pond Pine Woodlands and Pocosins, Bald Cypress – Tupelo Swamps, Non-Riverine Swamp Forests, and Peatland Atlantic White-Cedar Forests. Except in the maritime zone, the ***northern Coastal Plain*** generally lacks austral vegetation assemblages and contains upland and estuarine vegetation with more northern affinities. Fewer vegetation types are restricted to the northern part of the province, although both Tidal Freshwater Marshes and Tidal Hardwood Swamps occur only along the James River and estuarine rivers to the north.

The Piedmont Plateau

The Piedmont is a rolling to locally hilly landscape that lies between the Fall Line on the east and the Blue Ridge on the west. The land surface of the province slopes gradually from a general elevation of about 300 m (1,000 ft) near the Blue Ridge to roughly 50 m (160 ft) at the Fall Line. The underlying geology consists largely of resistant metamorphic and igneous rocks that have undergone a history of deposition, uplift, deformation, and erosion that is complex and difficult to interpret. Like the Coastal Plain, the Piedmont can be divided into eastern ("outer") and western ("inner") zones by topographic features, and into northern and southern sections by the James River. The ***outer Piedmont*** comprises the eastern two-thirds of the province, including several low, nearly level ***Mesozoic basins*** (*e.g.*, the Culpeper, Richmond, and Danville Basins). The latter are remnants of Triassic-age rift valleys that were intruded by magma (now diabase and basalts) and filled with sediments (now siltstones and sandstones) eroded off the Appalachians. The ***inner Piedmont*** contains the steeply rolling to hilly belt lying just east of the Blue Ridge, including a number of more or less isolated monadnocks or foothill ranges that reach elevations of about 300 m (1,000 ft) to more than 600 m (2,000 ft). Except in dissected or foothill areas, most of the province is covered by a thick mantle of soil and saprolite that has weathered in place and obscured much of the geologic parent material.

Mather Gorge is a product of down-cutting by the Potomac River at the Fall Line. Photo (c) Gary P. Fleming.

In the southern part of the state, the Piedmont is nearly 300 km (190 mi) wide, gradually narrowing to approximately 75 km (45 mi) wide in northern Virginia. Along the eastern border at the Fall Line, the change in geology from crystalline bedrock to unconsolidated sediments of the Coastal Plain accelerates the down-cutting of streams, creating a low escarpment with high-gradient flows along the major water courses. Rivers that cut across the Fall Line characteristically have dramatic rapids and falls such as those seen along the James River in Richmond, the Rappahannock west of Fredericksburg, and the Potomac River west of Washington, D.C. In the western Piedmont, monadnock ridges such as the Bull Run Mountains in northern Virginia, the Southwest Mountains near Charlottesville, and Smith Mountain southwest of Lynchburg are essentially geological and biological outliers of the Blue Ridge.

The vegetation of the Piedmont Plateau has been severely altered by a long history of clearing, agriculture, logging, and other anthropogenic disturbances. There is some evidence from the writings of early explorers that parts of the Piedmont were originally occupied by open, savanna-like woodlands and grasslands (Allard and Leonard 1962, Brown 2000, Maxwell 1910). Presumably, both natural fires and fires deliberately ignited by native Americans to drive game and clear land played major roles in the maintenance of pre-settlement savannas and grasslands. Except in the increasingly large urban and suburban areas, the province currently has a patchwork of secondary forests, pastures, and fields used for the production of feed grains or tobacco.

Most Piedmont forests have a history of repeated cutting, or have regenerated on former agricultural lands, some of which were abandoned more than 150 years ago. Recently disturbed Piedmont forests tend to have a large component of pines and shade-intolerant hardwoods. In the ***northern Piedmont***, Virginia pine (*Pinus virginiana*) and tulip-poplar (*Liriodendron tulipifera*) are prevalent early

successional trees. In the ***southern Piedmont***, shortleaf pine (*Pinus echinata*) and sweetgum (*Liquidambar styraciflua*) increase greatly in abundance, along with loblolly pine in the counties just west of the Fall Line.

The vegetation of the Piedmont is a patchwork of second-growth forests, pastures, and fields. Photo: Gary Fleming.

The composition of more mature hardwood forest communities varies with soils and topography. Dry, acidic soils support oak / heath forests, while more basic upland soils usually support oak-hickory forests. White oak (*Quercus alba*) is a ubiquitous dominant in both groups. Mixed forests of American beech, oaks, and tulip-poplar are common in mesic, acidic ravines throughout the Piedmont. More local are rich mesophytic forests, which are generally confined to ravines and river slopes underlain by mafic rocks such as amphibolite, diabase, or gabbro. Upland forests of the western monadnocks resemble those of the Blue Ridge. Forests of silver maple (*Acer saccharinum*), sycamore (*Platanus occidentalis*), American elm (*Ulmus americana*), boxelder (*Acer negundo*) and other flood-tolerant trees are well developed along the larger rivers that cross the Piedmont, particularly the Potomac, the Rappahannock, the James, and the Roanoke (Staunton).

Because it has less topographic variation than the Appalachian region and less extensive wetlands than the Coastal Plain, the Piedmont has relatively low vegetation diversity and fewer habitats supporting rare vegetation assemblages. Special habitats, however, are not entirely lacking. Granitic flatrocks and a suite of lithophytic plants that grow on them comprise an ecological community group endemic to the southeastern Piedmont from Alabama to Virginia. Another group found strictly in the Piedmont contains forests growing on locally extensive uplands with impermeable clay subsoils (hardpans) weathered from slates and fine-grained mafic rocks. Shallow, seasonally flooded upland depressions are also frequently associated with hardpans and support at least two unique palustrine wetland communities. Additional uncommon or rare communities documented in the Piedmont include seepage swamps and several types of outcrop barrens developed on mafic and ultramafic rocks.

The Appalachian Mountain provinces

The three physiographic provinces that intersect western Virginia are part of the great Appalachian Mountain region that extends from the Canadian maritime provinces south to northern Georgia and Alabama. The **Blue Ridge** forms the eastern portion of the state's mountain region, while the greater central part of the area lies within the **Ridge and Valley** province. The Allegheny Mountains and Cumberland Mountains, both belonging to Fenneman's (1938) **Appalachian Plateaus** province, extend into the peripheries of west-central and southwestern Virginia, respectively.

Western Virginia is geomorphologically and topographically quite diverse. The Blue Ridge is underlain by ancient (pre-Cambrian) continental basement rocks that were faulted, uplifted, and deformed during three discrete Appalachian orogenies. This province is usually divided into two distinctive subregions based on physiography and elevation. From Roanoke Gap northward, the ***northern Blue Ridge*** consists of a narrow, irregularly weathered series of peaks underlain by a core of resistant granites and metabasalts (greenstone), with resistant metasedimentary rocks exposed on the western flank. Maximum elevation in

the northern Blue Ridge is 1,288 m (4,225 ft) on Apple Orchard Mountain just south of the James River. South of Roanoke Gap, the Blue Ridge broadens into a more gently rolling plateau up to 80 km (50 mi) wide which is bordered on the southeast by a pronounced escarpment abruptly descending to the Piedmont. Elevations in this ***southern Blue Ridge*** section, which is underlain by a variety of ancient igneous and metamorphic rocks, reach 1,746 m (5,729 ft) at Mount Rogers, the highest in Virginia.

The ***Allegheny Mountains*** and ***Cumberland Mountains*** consist of closely spaced mountain ranges with deep intervening valleys. Underlying rocks are mildly folded or nearly horizontal sandstones, shales, and limestones of Devonian, Mississippian, and Pennsylvanian age. These strata were formed in the western portion of a huge Paleozoic sedimentary basin, which was uplifted during formation of the present-day Appalachian Mountains. Modern landforms resulted from folding and torsions during the great uplift, followed by deep and intricate stream incision of uplifted, plateau-like erosional surfaces. Elevations exceeding 1,200 m (4,000 ft) are attained in both subregions.

View of the Ridge and Valley province from the summit of Allegheny Mountain in Highland County. Northern hardwood forest on Allegheny Mountain (in foreground) gives way to drier, oak-dominated vegetation on the linear ridges beyond. Photo (c) Gary P. Fleming.

Most of western Virginia lies within the Ridge and Valley province, which was developed in the same Paleozoic basin in which the Cumberland and Allegheny Mountains were formed. In this part of the basin, however, the thick sedimentary deposits were extensively folded and thrust faulted during late Paleozoic orogeny. Ridge and valley alignments were determined by the long axes of the folds, while differential erosion of underlying bedrock formations controlled the structural development of current landforms. The present landscape of the region is characterized by long, parallel, narrow, even-crested ridges rising above intervening valleys of varying size, the largest and easternmost of which is the ***Valley of Virginia***, or ***Great Valley***. The linear strike-ridges are largely underlain by more resistant sandstones, quartzites, and shales, whereas valleys are largely underlain by less resistant limestones, dolomites, and shales. Much of the Ridge and Valley lies at relatively low elevation (< 900 m / 3,000 ft), with scattered peaks along the ridges between 1,200 and 1,400 m (4,000 and 4,600 ft). The most extensive strata of limestone and dolomite in Virginia are located in valleys of the Ridge and Valley province.

The northern part of Ridge and Valley drains northward to the Potomac River via two forks of the Shenandoah River and their tributaries. In west-central Virginia, the James River flows across the Ridge and Valley and cuts a gorge through the Blue Ridge on route to the Chesapeake Bay. The smaller Roanoke River, also an Atlantic slope drainage, cuts through the Blue Ridge near the City of Roanoke. The southwestern mountains of Virginia are drained by west or south-flowing streams of the Ohio and Tennessee River systems, principally the New River, the Clinch River, the Powell River, and the forks of the Holston River.

Considerable topographic heterogeneity in western Virginia induces a diversity of local weather conditions and microclimates. As a rule, average temperatures decrease by 6.4° C (11.5° F) with every 1,000 m (3,280 ft) in elevation (Woodward and Hoffman 1991); thus sub-boreal to boreal microclimates prevail at some of the highest elevations. Mean annual precipitation varies from about 850 mm (33.5 in) at lower elevations of the Ridge and Valley to more than 1,300 mm (51.2 in) on some of the higher peaks of the Blue Ridge and Allegheny Mountains (Hayden 1979). The climate of the Ridge and Valley region north of the New River is significantly warmer and drier than that of both the Blue Ridge and the mountains to the west. This condition is due to lower average elevation and the modification of climatic patterns by regional topography. Prevailing westerly air masses are forced upward over the Appalachians and release most of their moisture on the windward side of the mountains, leaving the Ridge and Valley in a "rain shadow" of the higher Allegheny ridges to the west. East of the Ridge and Valley, this effect is ameliorated on the Blue Ridge by moisture-laden Atlantic air masses that move inland and are forced upward by the Blue Ridge escarpment, resulting in heavy rainfalls and snowfalls in that region (Woodward and Hoffman 1991).

The natural vegetation of Virginia's Appalachian region was formerly characterized by various mixtures of oaks (*Quercus* spp.) and American chestnut (*Castanea dentata*), with smaller inclusions of mixed mesophytic forest in coves, ravines, and other fertile sites (Braun 1950). Following the elimination of American chestnut as an overstory tree by an introduced fungal blight (*Cryphonectria parasitica*) by about 1940, this region is now mostly described as mixed oak forest (Küchler 1964, Stephenson *et al*. 1993). There is little evidence that chestnut was important in forests typical of carbonate (limestone and dolomite) substrates of the region, and the general vegetation of limestone or dolomitic valley slopes in Virginia may be closer to that of Braun's more westerly Oak-Hickory and Western Mesophytic Forest Regions.

Differences in the composition of major forest communities from one province and subregion to the next are typically related to differences in soils and elevation. Because it is underlain by large areas of base-rich metabasalts and granitic rocks, much of the northern Blue Ridge supports relatively species-rich oak-hickory forests. By contrast, the matrix forests of the sandstone ridges of the Ridge and Valley and Cumberland Mountains are oak forests with heath-dominated shrub layers and relatively low species richness. At higher elevations throughout the northern Blue Ridge and Ridge and Valley, forests dominated by northern red oak (*Quercus rubra*) have replaced the former oak-chestnut forests. Drier slopes on lower-elevation limestone or dolomite hills and valley side slopes feature forests containing chinakapin oak (*Quercus muhlenbergii*) and other oaks, sugar and black maples (*Acer nigrum*), hickories (*Carya* spp.), eastern redbud (*Cercis canadensis* var. *canadensis*), and a patchy but very diverse assemblage of nutrient-demanding and calcium-loving herbs.

View toward North Carolina from the high-elevation landscape of Whitetop Mountain, Balsam Mountains, Washington County. Photo: Gary Fleming.

The Balsam Mountains of the southern Blue Ridge (Smyth, Grayson, and Washington Counties) encompass Virginia's most extensive high-elevation landscape. Here, as well as in the Allegheny Mountains of northwest Highland County, northern hardwood and red spruce (*Picea rubens*) forests make up the prevalent vegetation cover. Coniferous forests dominated by Fraser fir (*Abies fraseri*) occur only at the highest elevations on Mount Rogers.

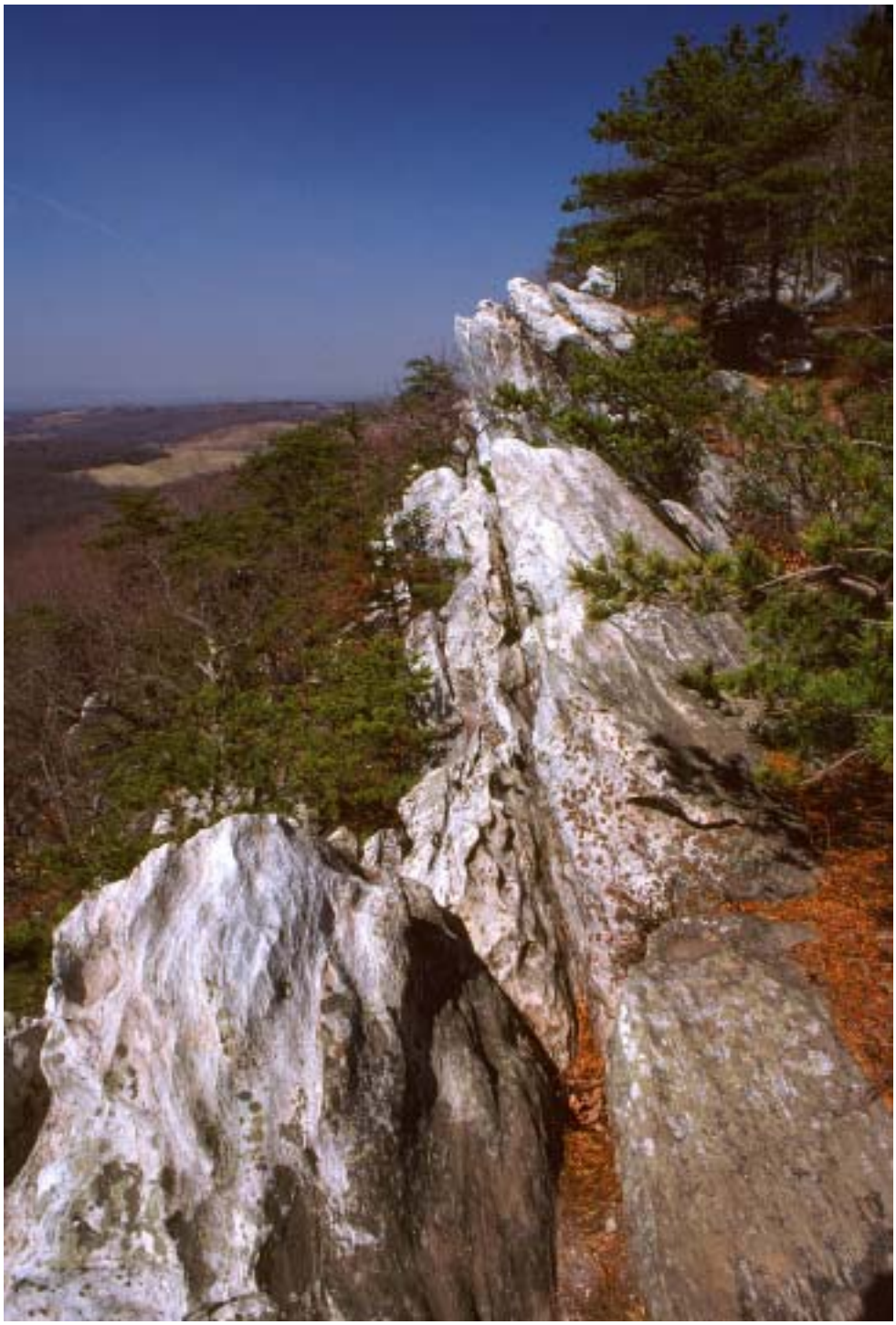
At low and middle elevations, coves, concave slopes, and other protected landforms which receive abundant moisture support several types of mixed mesophytic forest vegetation. Sites with fertile soils contain some of Virginia's lushest forests with breathtaking displays of vernal wildflowers growing under mixed overstories of sugar maple (*Acer saccharum* var. *saccharum*), basswoods (*Tilia americana* var. *americana* and var. *heterophylla*), yellow buckeye (*Aesculus flava*, primarily in southwestern Virginia), white ash (*Fraxinus americana*), and other tall hardwoods. On similar sites with infertile soils derived from sandstone or other acidic rocks, the overstory contains variable mixtures of eastern hemlock (*Tsuga canadensis*), tulip-poplar (*Liriodendron tulipifera*), birches (*Betula* spp.), magnolias (*Magnolia* spp.), white pine (*Pinus strobus*), red maple (*Acer rubrum*), and oaks. Dense colonies of evergreen rhododendrons, particular great rhododendron (*Rhododendron maximum*) but including Catawba rhododendron (*R. catawbiense*) on the northern Blue Ridge, are characteristic of these more acidic cove forests.

The exposed granitic summit of Old Rag Mountain in the northern Blue Ridge supports a rare type of High-Elevation Outcrop Barrens. Photo (c) Gary P. Fleming.

Because of its climatic variability and diversity of soils weathered from different substrates, western Virginia in fact supports an impressive range of natural vegetation, including a number of rare and localized community types (Fleming and Coulling 2001). Rare natural communities of cool microsites include high-elevation bogs, boulderfields, outcrop barrens, and grassy balds. A distinctive floristic feature of these habitats is the frequent presence of long-range northern disjuncts that are likely relicts of wider distributions during the Pleistocene. At lower elevations, several rare seepage and depression wetlands occur on acidic, mafic, and ultramafic substrates. Most noteworthy are the Shenandoah Valley Sinkhole Poles, an ecological group of endemic, seasonally flooded vegetation types; calcareous and mafic fens; and wet grassland vegetation with distinct affinities to midwestern prairies.

Dry, south- or west-facing shale slopes in the rain-deprived Ridge and Valley support several types of xerophilic vegetation, including the well known shale barrens (Braunschweig *et al*. 1999), whose distribution is centered in west-central Virginia and adjacent West Virginia. Environmentally similar habitats on carbonate rocks support calcareous barrens dominated by eastern red-cedar (*Juniperus virginiana* var. *virginiana*) and prairie grasses (Ludwig 1999). Additional barrens and woodland vegetation types occur on metabasalt and other mafic formations of the Blue Ridge (Fleming 1993, Rawinski and Wieboldt 1993), as well as on sandstones of the Ridge and Valley. Perhaps the rarest edaphically limited forest vegetation type in Virginia is the Carolina Hemlock (*Tsuga caroliniana*) forest that is known from just a few Blue Ridge and Ridge and Valley sites south of the James River. More widespread and forming locally large patches are pyrophytic woodlands of pitch pine (*Pinus rigida*), table-mountain pine (*P. pungens*), chestnut oak, bear oak (*Quercus ilicifolia*), and various ericaceous

shrubs. These fire-adapted woodlands are characteristic of xeric, exposed topography on most sedimentary ridges but are currently undergoing structural and compositional alterations because of the recent exclusion or suppression of fires from this landscape.



Woodlands dominated by table-mountain pine (*Pinus pungens*, above) , pitch pine (*P. rigida*), and ericaceous shrubs are widespread on xeric, exposed ridges throughout western Virginia. Bull Run Mountains Natural Area Preserve, Fauquier County. Photo (c) Gary P. Fleming

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